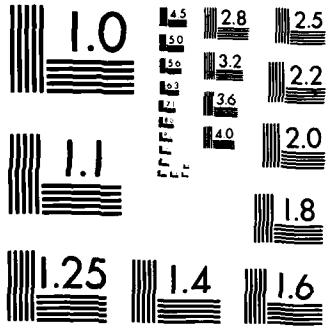
AD-A158 941 EFFECTIVE BEHAVIOR OF COMPOSITE MATERIALS(U) NEW YORK 1/1
UNIV NY COURANT INST OF MATHEMATICAL SCIENCES
G C PAPANICOLAOU 23 APR 85 5274192 AFOSR-TR-85-0671
UNCLASSIFIED AFOSR-80-0228 F/G 11/4 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

UNCLASSIFIED
SECURITY CLASSIFICATION

AD-A158 941

ATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY Unclassified	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; Distribution Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 5274192	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 85-0671
6a. NAME OF PERFORMING ORGANIZATION New York University, Courant Institute of Math. Sciences	6b. OFFICE SYMBOL (If applicable)
7a. NAME OF MONITORING ORGANIZATION AFOSR/NM	
6c. ADDRESS (City, State and ZIP Code) 251 Mercer St. New York, NY 10012	7b. ADDRESS (City, State and ZIP Code) Bldg 410 Bolling AFB D.C. 20332-6448
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR/PKZ	8b. OFFICE SYMBOL (If applicable) NM
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-80-0228	
8c. ADDRESS (City, State and ZIP Code) Bldg. 410 Bolling AFB D.C. 20332-6448	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
61102F	2304	A4	--------

11. TITLE (Include Security Classification) Effective Behavior of Composite Materials	
12. PERSONAL AUTHOR(S) Prof. George C. Papanicolaou	

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Final	FROM 1 Sep 83 TO 30 Nov 84	1985 APR 23	5

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	Composite Materials
XXXX	XXXXXXXXX	XXXXX	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

SEE ATTACHED

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☒ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION Unclassified

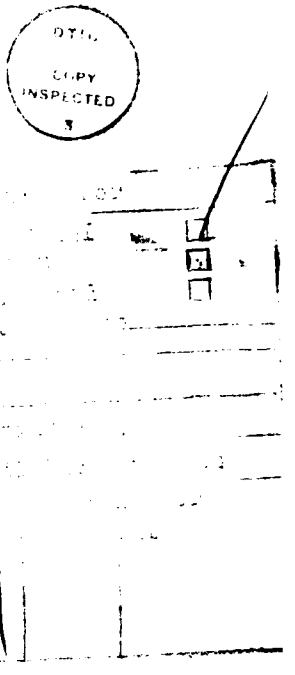
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code)	22c. OFFICE SYMBOL
Dr. Buchal	(202) 767-4939	AFOSR/NM

AFOSR-TR- 0371

Final Report

Contract AFOSR 80-0228

1 September 1983 - 30 November 1984



Title

EFFECTIVE BEHAVIOR OF COMPOSITE MATERIALS

Principal Investigator

George C. Papanicolaou

Courant Institute
251 Mercer Street
New York, N.Y. 10012

During this period two thesis students have completed their work and have obtained the Ph.D. (September 1984):

M. Z. Guo -- Selfdiffusion of interacting Brownian motions

K. Golden -- Analytic continuation method for effective parameters

Guo is back in China now while Ken Golden won a National Science Foundation Fellowship and is at Rutgers University. In addition to Guo and Golden, B. Le Mesurier is supported by AFOSR for his thesis work on the nonlinear Schrödinger equation.

A. S. Sznitman was partially supported by AFOSR. P. L. Sulem and C. Sulem visited with us during June and July 1984, supported by AFOSR. Renato Spigler was also partially supported.

A list of papers, published and submitted for publication, is attached.

The main results of our work fall into three categories which we list in order of significance to our present and future work.

1. Focusing a singularity of the nonlinear Schrödinger equation.

We have solved by a careful analytical-numerical method the basic question of what the local rate of blow-up is for solutions of the nonlinear Schrödinger equation with cubic nonlinearity in 2 space dimensions. This problem is a basic one that arises in many aspects of nonlinear wave propagation.

The mathematical problem is at the center of a canonical problem to determine the nature of the self focusing singularity. We have found that the blowup is not like $t^{-2/3}$ ($t \to 0$ corresponds to reaching the singularity) by rather $t^{-\frac{1}{2}}$ times a slowly varying function that goes to infinity slower than $\log t$.

2. Selfdiffusion of interacting Brownian motions.

Using methods of wave propagation in random media that we had developed earlier, we were able to study the effective behavior of a tagged Brownian particle in interaction with an infinite system of other such particles. The problem is technically difficult but of basic importance in composite fluid materials, suspensions for example. This is the first complete mathematical theory for the problem.

3. Bounds for effective properties of composites by analytic continuation

Following earlier work (supported by AFOSR) on the use of analytic continuation, Golden and Papanicolaou obtained bounds for multicomponent media that was previously unknown and impossible to get by variational methods. The reason variational methods fail is because the problem is not selfadjoint. Interest in the nonselfadjoint case comes from trying to obtain frequency dependent bounds (not just static ones). The analytic continuation method was known to work only for two component

materials. In our work we extend it to multicomponent materials by using the theory of several complex variables.

Copies of the papers listed on the following page were sent to AFOSR on August 3, 1984, along with our proposal for renewal of this grant.

LIST OF PUBLICATIONS

Convection of Microstructure and Related Problems, D.W. McLaughlin, G.C. Papanicolaou and O.R. Pironneau, SIAM J. Appl. Math. To appear June 1985.

A Random Wave Process, D.A. Dawson and G.C. Papanicolaou, Appl. Math. Optim. 12 (1984) pp. 97-114.

Dynamic Theory of Suspensions with Brownian Effects, R. Caflisch and G.C. Papanicolaou, SIAM J. Appl. Math. 43 (1983) pp. 885-906.

Macroscopic Properties of Composites, Bubbly Fluids, Suspensions and Related Problems, G.C. Papanicolaou, Eyrolles, Paris, 1985.

Bounds for Effective Parameters of Heterogeneous Media by Analytic Continuation, K. Golden and G. Papanicolaou, J. Stat. Phys. To appear.

Focusing Singularity for the Nonlinear Schroedinger Equation, G. Papanicolaou, D. McLaughlin, P.L. Sulem, C. Sulem and B. LeMesurier, SIAM J. Appl. Math. Submitted.

Self-Diffusion of Interacting Brownian Particles, P rt I, M.Z. Guo and G. Papanicolaou, Annals of Probability. Submitted.

Nonlinear Parametric Oscillations in Certain Stochastic Systems: A Random van der Pol Oscillator, Renato Spigler, J. Stat. Phys. Submitted.

A Stochastic Model for Lower Hybrid Wave Scattering by Density Fluctuations, William Grossmann and Renato Spigler, Phys. of Fluids. To appear.

A Stochastic Model for Nonlinear Oscillators of Duffing Type, Renato Spigler, SIAM J. Appl. Math.

A Propagation of Chaos Result for Burgers' Equation, A.S. Sznitman, Zeitshrift für Wahr. Submitted.

A Multidimensional Process Involving Local Time, A.S. Sznitman and S.R.S. Varadhan, Zeitshrift für Wahr. Submitted.

Bounds for Effective Parameters of Multicomponent Media by Analytic Continuation II, K. Golden, J. Mech. of Solids and Structures.

END

FILMED

10-85

DTIC